MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

PCM0016 – CHEMISTRY

(All sections / Groups)

14 MARCH 2018
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages only excluding the cover page.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [20 MARKS]

(a) Complete the table below by writing the chemical formulae, naming the compounds and identify the compounds as ionic or molecular:

Chemical formula	Name of compound	Ionic or molecular?
$Cu(NO_3)_2$	(i)	(ii)
(iii)	Silicon tetrachloride	(iv)
HCl *(s)*	(v)	(vi)
(vii)	Cobalt (II) oxide	(viii)

[4 marks]

(b) An amount of the freon, CF_3Cl with a mass of 1.63×10^4 g escaped from a refrigerator. Calculate the number of freon molecules and fluorine atoms escaped?
[Atomic mass: C = 12.0; F = 19.0; Cl = 35.5; $N_A = 6.023 \times 10^{23}$] [1.5 marks]

(c) Ethene, C_2H_4, was prepared from ethanol, C_2H_5OH, by the following reaction:

$$C_2H_5OH \longrightarrow C_2H_4 + H_2O$$

A chemist reacted 10.2 g of ethanol, C_2H_5OH, and obtained 4.5 g of ethene. Calculate the percentage yield of ethene in the reaction.
[Atomic mass: C = 12.0; H = 1.0; O = 16.0] [2.5 marks]

(d) The enthalpy of combustion of one mole of ethanol is −1371 kJ. The density of ethanol is 0.789 g/mL. Calculate the heat energy released when 0.25 L of ethanol is burned.
[Atomic mass: C = 12.0; H = 1.0; O = 16.0] [2 marks]

(e) The three silicon isotopes have atomic masses and relative abundances of 27.9769 amu (92.12%), 28.9765 amu (4.79%) and 29.9738 amu (3.09%). Calculate the atomic mass of silicon. [1.5 marks]

(f) Gasoline (which can be considered to be octane, C_8H_{18}) burns in oxygen to produce carbon dioxide and water.
[Density of gasoline = 0.81 g/mL; 1 gal = 3.78 L; Atomic mass: C = 12.0; H = 1.0]

(i) Write the balanced equation for the above reaction. [1 mark]
(ii) Find the volume of oxygen at STP that is necessary to react with 1.0 gal of gasoline. [2.5 marks]
(iii) What volume of carbon dioxide at these same conditions is produced as a result of the combustion? [1 mark]

Continued...

(g) Gases that deviate from ideality are known as Real Gases, which originate from two assumptions:

(i) In short, explain the two assumptions. [2 marks]
(ii) State when real gases will exhibit ideal behavior. [1 mark]

(h) Sketch a graph of P versus V in accordance to Boyle's Law. [1 mark]

QUESTION 2 [15 MARKS]

(a) The following combinations of four quantum numbers are not allowed. Correct each set by changing only one quantum number. Then, give the orbital name for each of the following:

False quantum numbers	Corrected quantum numbers	Name of orbital (e.g.: 1*s*, 3*p*)
(i) (3, 2, 1, 1)		
(ii) (4, 3, +1/2, -1/2)		

[2 marks]

(b) Draw the Lewis structure and complete the table below:

Compound	Lewis structure	Molecular geometry
(i) BF_3		
(ii) $(CO_3)^{2-}$		

[3 marks]

(c) For main-group elements, explain the observed trends in atomic radius as you move across a period in the Periodic Table. [1 mark]

(d) Sucrose, $C_{12}H_{22}O_{11}$, reacts slowly with water in the presence of an acid to form two other sugars, glucose and fructose, both of which have the same molecular formula with different structures.

$$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 \text{ (glucose)} + C_6H_{12}O_6 \text{ (fructose)}$$

The reaction is first order and has a rate constant of $6.2 \times 10^{-5}\ s^{-1}$ at 35 °C. Suppose that the initial concentration of sucrose in the solution is 0.40 M.

(i) What will the sucrose concentration be after 2.0 hours? [1.5 marks]
(ii) How long will it take for $[C_{12}H_{22}O_{11}]$ to drop to 0.30 M? [1.5 marks]

Continued...

(e) In a reaction of A and B, the order of reaction with respect to A is first order and the order of reaction with respect to B is second order. The rate constant, k is 4.2×10^{-4} 'unit'. Write the rate law for the reaction and state the 'unit' for the rate constant, k. [1 mark]

(f) Draw the electronic configuration and deduce the group and period in the Periodic Table for following elements:

Element	Electronic configuration	Group and period
(i) Calcium		
(ii) Chlorine		

[3 marks]

(g) Consider the following equilibrium:

$$A(g) + B(g) \rightleftharpoons 2C(g), \quad \Delta H°_{rxn} > 0$$

(i) Assume the equilibrium concentration of the reacting species are [A] = 0.050 M, [B] = 0.045 M, and [C] = 0.086 M. Calculate K_c for the reaction. [1 mark]

(ii) If temperature is raised, explain which way will the reaction shift. [1 mark]

QUESTION 3 [15 MARKS]

(a) Calculate the pH of each of the following solutions.
[Atomic mass: Co = 59.0; H = 1.0; O = 16.0; C = 12.0]

(i) A cobalt (III) hydroxide solution made from 7.06×10^{-3} g cobalt (III) hydroxide and enough water to make 3.0 L of solution. [2 marks]

(ii) 0.15 M HCOOH solution at 25 °C (K_a for HCOOH = 1.8×10^{-4}). [2.5 marks]

(b) Consider the following equation:

$$2HOCl(aq) + 2H^+(aq) + 2e^- \rightarrow Cl_2(g) + 2H_2O(l)$$

(i) Determine the oxidation number of all elements in HOCl. [1.5 marks]

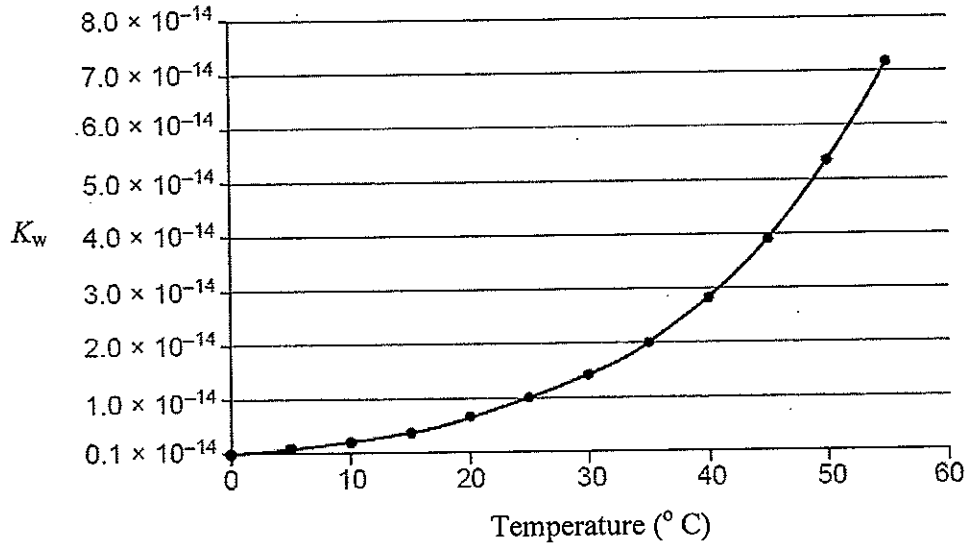
(ii) When HOCl acts as an oxidising agent, one of the atoms in the molecule is reduced. Identify the atom and justify your answer. [1 mark]

(c) In oxoacids, explain why acid strength increases as the number of oxygen attached to the central atom increases. [1.5 marks]

(d) Explain why hydrofluoric acid (HF) is a weak acid. [1 mark]

Continued...

(e) The ionic product of water, K_w, measures the extent of dissociation of water. K_w varies with temperature. Figure below shows the variation of K_w between 0 °C and 55 °C. Answer the questions that follow.



(i) Write the expression for K_w. [0.5 mark]

(ii) Calculate the $OH^-(aq)$ concentration in an aqueous solution of hydrochloric acid with a pH of 3.15 at 25 °C. [1 mark]

(iii) Determine the pH of pure water at body temperature, 37 °C. [1 mark]

(f) For the reaction below, indicate the Brønsted-Lowry acid and conjugate base.

$$HC_2H_3O_2(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + C_2H_3O_2^-(aq)$$ [1 mark]

(g) Silver from AgCl with density of 10.49 g/cm^3 is electrodeposited on a metallic vessel of surface area 800 cm^2 by passing a current of 0.2 A for 3 hours. Calculate the thickness of the silver deposited.
[Atomic mass: Ag = 107.9; Faraday constant = 96500 C/mol e^-] [2 marks]

End of Paper